

- XX. "Influence of Acids and Alkalis upon the Electrotonic Currents of Medullated Nerve." By AUGUSTUS W. WALLER, M.D., F.R.S.
- XXI. "On the Distribution of Frequency (Variation and Correlation) of the Barometric Height at diverse Stations." By KARL PEARSON, M.A., F.R.S., University College, London, and Miss ALICE LEE, Bedford College.
- XXII. "On the Openings in the Wall of the Body-cavity of Vertebrates." By E. J. BLES. Communicated by Dr. HANS GADOW, F.R.S.
- XXIII. "Electrification of Air, of Vapour of Water, and of other Gases." By LORD KELVIN, G.C.V.O., F.R.S., MAGNUS MACLEAN, D.Sc., F.R.S.E., and ALEXANDER GALT, B.Sc., F.R.S.E.
- XXIV. "Note on recent Investigations on the Mechanical Equivalent of Heat." By E. H. GRIFFITHS, M.A., F.R.S.

The Society adjourned over the Long Vacation to Thursday, November 18.

"An Investigation on the Variability of the Human Skeleton with especial Reference to the Naqada Race, discovered by Professor Flinders Petrie in his Explorations in Egypt." By ERNEST WARREN, B.Sc. Communicated by Professor W. F. R. WELDON, F.R.S. Received April 2,—Read June 3, 1897.

(Abstract.)

Charles Darwin was the first to point out the great importance of the study of the nature and causes of variation. Since his time, two methods of investigation have been adopted; in the one the obvious and strongly pronounced variations are selected and the probability of species having been derived from such "sports" is analysed and discussed. According to the second method a population of a species is taken, and the condition of the organs in each individual is determined. It is believed that this latter statistical method will lead to more accurate ideas as to the causes of variation and as to the part which variation has played in the origin of species.

As in all other scientific investigations, the course pursued by statistical inquiry is, firstly, to record facts, and, secondly, to generalise from the facts. The facts consist of the nature of the

variation and the relationships which obtain between one variation and another; these may be expressed by diagrams or by means of a few numerical constants. After the data have thus been expressed in a convenient form, they are examined to see if any legitimate theory or generalisation can be drawn from them. If not, the facts nevertheless possess a value, for light is sure to be shed on them by future investigations, since the subject of variation is still in its infancy.

To obtain an accurate knowledge of the variability displayed by man and the mutual relationships of the different organs is surely a subject of great interest and of both practical and theoretical importance. An exceptionally favourable opportunity for studying the variation exhibited by the human skeleton in a fairly homogeneous race was presented by the kindness of Professor Petrie in placing at my disposal the skeletons of the "New Race" which he has recently brought over from Egypt. There were remains of about 400 skeletons.

Although numerous bone-measurements have been made, yet generally the number in each race has been too small to be of any statistical use, and even when fairly numerous measurements have been made on a single race, the results have been dealt with in a very inadequate manner. So far as I am aware, the present investigation is the first where the limb-bones have been measured for statistical purposes, and it is also, I believe, the largest series of measurements that have been made on the human skeleton.

The paper deals primarily with the nature of the variation in the length of the limb-bones and of the correlation between the bones. The sacrum and pectoral girdle have also been studied as far as the material would allow. Besides this I have made some observations on the more important ethnological characters which the material exhibited.

The measurements of each bone are recorded in the tables, and these constitute the foundation for all theory, and in the future will be of use for discovering fresh relationships and for correcting any erroneous ideas.

In the following paragraphs some of the more important conclusions are briefly recapitulated:—

(1) The variability of the limb-bones is roughly proportional to their absolute length, and hence expressing the variability in terms of the mean we tend to get a constant ratio.

The ratio $\frac{\text{standard deviation} \times 100}{\text{mean}}$ fluctuates about 5. We do not admit that this ratio (called the "coefficient of variation") always expresses the variability of an organ as it concerns the individual.

(2) The mode of dispersion of the variations about the mean would appear to be distinctly skew, and the range given by the theoretical curves would seem to be generally limited. The frequency curves are steeper on the negative side than on the positive side of the origin, hence there is greater variability towards long bones than towards short bones, that is, abnormality in the direction of giants is greater than in the direction of dwarfs.

(3) The femora of the New Race were strongly pilastric, occasionally they were platymeric, but then the pilastric index* was generally low. This observation is in accordance with Professor Manouvrier's statement that platymerism is more frequently exhibited in femora with low than with high pilastric indices.

(4) The length of the head + neck of the femur in proportion to the total length of the bone is greater in man than in woman. I find that in the New Race the angle of the neck with the shaft is larger in woman than in man, though on somewhat scant data the reverse is stated to be the case in Europeans.

(5) In the New Race the angle of torsion of the femur is much greater than in Europeans; it is suggested that this angle may be found to be a race character.

(6) The angle which the condyles of the femur make with the horizontal plane, when the bone is held upright in the maximum position, is greater in woman than in man. This would appear to be due to the greater width of the pelvis. It is suggested that this angle might yield valuable information as to the width of the pelvis in prehistoric peoples.

(7) The tibiæ exhibited platynemia to a marked degree. A correlation is believed to exist between the flattening of the tibia and the condition of the pilastric of the femur; hence as the pilastric condition would seem to be produced by a vigorous musculature platynemia may probably be referred to a similar cause, and so it is not an atavistic character.

(8) Perforation of the septum between the olecranon and coronoid fossæ of the humerus was very frequent. Also it occurred more often in the female than in the male, and on the left side than on the right. It is suggested that in man this perforation is frequently incidental, and is due to the impact of the beak of the olecranon against the septum in extension of the arm.

(9) Many of the ulnæ were conspicuously incurved. The olecranon was remarkable for its variation in size.

(10) The femur + tibia is longer on the left side than on the right, while the right humerus + radius is very considerably greater

* Pilastric index = $\frac{\text{antero-posterior diameter} \times 100}{\text{diameter from right to left}}$. The measurements are taken at the middle of the shaft.

than the left. The difference between the means of the two sides would appear to vary in different races; also it is distinctly greater in woman than in man.

(11) The absolute correlation between the lengths of the long bones is high, while, on the other hand, the correlation between length and breadth would appear to be weak.

(12) On comparing with the Aino it would seem that serially homologous bones are more strongly correlated with one another than are non-homologous bones. Also the femur and tibia are more closely correlated than the humerus and radius. Distal bones would appear to be somewhat less correlated with one another than are proximal bones, *e.g.*, there is slightly less correlation between the tibia and radius than between the femur and humerus.

In the New Race woman was distinctly less correlated than man.

(13) Sometimes it is desirable to refer the variations to some standard, such as stature. The index-correlations tend to be lower than the absolute correlations. From the results we have obtained it appears doubtful as to what meaning we can attach to the difference between the observed correlation of ratios and Professor Pearson's "spurious correlation."

(14) The New Race approached the Negro in the proportional lengths of the limb-bones to one another, but the sacral and scapular indices were nearly identical with those of Europeans.

"The average Contribution of each several Ancestor to the total Heritage of the Offspring." By FRANCIS GALTON, D.C.L., Sc.D., F.R.S. Received and Read June 3, 1897.

In the following memoir the truth will be verified in a particular instance, of a statistical law of heredity that appears to be universally applicable to bisexual descent. I stated it briefly and with hesitation in my book 'Natural Inheritance' (Macmillan, 1889; page 134), because it was then unsupported by sufficient evidence. Its existence was originally suggested by general considerations, and it might, as will be shown, have been inferred from them with considerable assurance. Consequently, as it is now found to hold good in a special case, there are strong grounds for believing it to be a general law of heredity.

I have had great difficulty in obtaining a sufficient amount of suitable evidence for the purpose of verification. A somewhat extensive series of experiments with moths were carried on, in order to supply it, but they unfortunately failed, partly owing to the diminishing fertility of successive broods and partly to the large disturbing effects of differences in food and environment on different